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ABSTRACT

This study assessed level and structure differences across sex and ethnic groups on a newly developed multiple aptitude battery, called the Ball Aptitude Battery (BAB), and established and examined the concurrent and differential validities of the battery relative to different groups. The 17 Ball ability variables are: clerical test; idea fluency; tonal memory; pitch discrimination; rhythm memory; inductive reasoning; word association; writing speed; paper folding; vocabulary; ideaphoria; finger dexterity-left; finger dexterity-right; grip-left; grip-right; shape assembly; and analytical reasoning. BAB test data were collected from 1,009 high school students from Illinois and Texas representing both sexes and three ethnic group (Black, White, Hispanic). Additional criterion data (overall grade point average and 10 academic course grades) were obtained for 801 students. Data showed that ethnic group and sex variables were associated with level differences, but not with the pattern and structure of abilities as measured by the Ball Aptitude Battery. Also, the simplicity of factor patterns indicate that redundancy is minimal for the tests. Findings of few significant differential validities for sex and ethnic groups indicate that the same battery of ability tests can serve for different ethnic and sex groups. (Author/BS)

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TECHNICAL REPORT

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Technical Report No. 7

ABILITY TEST PERFORMANCE AND TEST VALIDITY DIFFERENCE AMONG SEX AND ETHNIC GROUPS

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Abstract

Purposes of the present study are to assess level and structure differences across sex and ethnic groups on a newly developed multiple aptitude battery, call the Ball Aptitude Battery, and to establish and examine the concurrent and differential validities of the battery relative to different groups. Data showed that ethnic group and sex variables were associated with level differences, but not with the pattern and structure of abilities as measured by the Ball Aptitutde Battery. Also, the simplicity of factor patterns indicate that redundancy is minimal for the tests. Furthermore, the findings of few significiant differential validities for sex and ethnic groups indicate that the same battery of ability tests can serve for different ethnic and sex groups.

Ability Test Performance and Test Validity Differences Among Sex and Ethnic Groups[1]

This study was a part of large scale longitudinal research project aimed at developing and standardizing a multiple aptitude battery, called the Ball Aptitude Battery (BAB).

Purposes of the present study are (a) to assess if level differences in performance exist on the BAB and in 10 academic course subjects across groups classified by sex, ethnic membership, location, and socioeconomic status (SES), (b) to examine the differences in the factor structure of abilities across sex and ethnic groups, and (c) to establish and examine the concurrent and differential validities of the BAB relative to different sex and ethnic groups.

Method

Instruments

The 17 ability variables involved in the present study were measured with the Ball Aptitude Battery, a test battery developed by The Ball Foundation (Sung & Dawis, 1981a; Sung, Dawis & Dohm, 1981). The 17 ability variables, which are designed to provide reference dimensions for the linear description of specific skills, may be described briefly as follows:

1. Clerical Test: Measures the ability to perceive visual details, similarity and differences.

2. Idea Fluency: Measures the ability to produce ideas of alternative uses of a given object.

3. Tonal Memory: Measures the ability to remember a series of tones.

4. Pitch Discrimination: Measures the ability to differentiate between tones varying in pitch.

5. Rhythm Memory: Measures the ability to differentiate between two different rhythmic patterns.

6. Inductive Reasoning: Measures the ability to identify a rule, to reason from specific information to a general principle.

7. Word Association: Measures the similarity of response to the normative word-association responses.

8. Writing Speed: Measures the ability to write fast.

9. Paper Folding: Measures the ability to visualize in two-dimensional space.

10. Vocabulary: Measures the ability to choose the right word that represents an idea.

11. Ideaphoria: Measures the ability to generate a rapid and abundant flow of words and ideas.

12. Finger Dexterity-Left: Measures the ability of the left hand to make skillful, controlled manipulation of small objects, principally involving finger movement.

13. Finger Dexterity-Right: Same for the right hand.

14. Grip-Left: Measures the strength of grip of the left hand.

15. Grip-Right: Same for the right hand.

16. Shape Assembly: Measures the ability to visualize in three-dimensional space.

17. Analytical Reasoning: Measures the ability to reason from general principle to specific information, and from specific examples to general principle, and the ability to organize related concepts in a systematic manner.

Subjects and Data Collection

The subjects who participated in the present study consisted of 1,009 high school students from Illinois and Texas, representing both sexes and three ethnic groups (black, hispanic, and qhite). The sample was 54% female; 51% were from Illinois; 17% were hispanic, 26% were black, and 53% were white. When socioeconomic status distribution for the total sample was divided into thirds, almost half of the black students (47%) and hispanic students (46%) were in the lowest third of the distribution. In

addition to the collection of the BAB test data, criterion data--overall grade point average(GPA) and grades in 10 academic courses--were obtained for 801 students.

Results and Discussion

Tables 1 and 2 show the means (Ms) and standard deviations (SDs) for the BAB tests for each race-by-sex group and for the total group. To examine level differences in predictor and criterion performance, a series of 3 (SES) x 2 (Sex) x 2 (Location) x 3 (Ethnic Group) Analyses of Variance were performed with SES, Sex, Location, and Ethnic Group as independent variables and each of the BAB's 17 ability variables and 10 academic course grades serving as dependent variables.

Insert Tables 1 and 2 about here

Significant sex differences in mean scores were observed for Clerical, spatial (Paper Folding and Shape Assembly), Writing Speed, Finger Dexterity-Right, Word Association, and Grip tests. Significant ethnic group differences in mean scores were obtained for Vocabulary, Inductive Reasoning, Analytical Reasoning, Pitch Discrimination, Tonal Memory, Paper Folding, Idea Fluency, Ideaphoria, and Shape Assembly tests. Two-way interaction effects be-

tween paired independent variables were significant only for Clerical, Writing Speed, Finger Dexterity-Left, and Grip-Left. With regard to the 10 academic criteria, no Location effect and few SES effects were observed. Sex effects were shown for all academic criteria except Chemistry, while Ethnic Group effect was significant for all but Chemistry, English, and Physics.

When SES was statistically controlled as a covariate, the results of Analyses of Covariance produced significant proportions of explained variance for all of the tests except Rhythm at the .001 level of significance. Ethnic group accounted for the larger share of the explained variance for the majority of tests: Idea Fluency, Tonal Memory, Pitch Discrimination, Inductive Reasoning, Paper Folding, Vocabulary, Ideaphoria, Shape Assembly, and Analytical Reasoning. Meanwhile, sex accounted for the larger share of the explained variance for Clerical, Word Association, Writing Speed, Finger Dexterity-Left, Finger Dexterity-Right, and especially Grip-Left and Grip-Right (Sung & Dawis, 1981b). The findings of the present study show that the ethnic group variable was more influential than the sex variable in accounting for ability test score variance.

On the other hand, a series of factor analyses across sex and ethnic groups clearly demonstrated that about the same number of

interpretable factors were obtained for each subgroup, ranging from 10 (for white and female groups) to 12 (for black group) with average communalities of above .50 on each variable.

Insert Table 3 about here

As shown in Table 3, when the coefficients of factor congruence (Harman, 1967) were calculated between the corresponding factor for different sex and ethnic groups, it was found that the factor structure of the BAB tests were similar across sex and ethnic groups. In other words, the factors identified in one ethnic group or sex were similar to the corresponding factors in other groups. One exception was that the vocabulary factor was similar between sex groups but not among ethnic groups.

These results clearly show that while the ethnic and sex variables did affect the level of individual differences in abilities studied, they had much less effect on the structure underlying these individual differences.

With regard to the 10 academic criteria (English, Economics, Physics, and Social Studies), no Location effect and four SES effects were observed. Sex effects were shown for all academic criteria except Chemistry, while Ethnic Group effects were signif-

icant for all but Chemistry, English, and Physics. Guion (1976) pointed out that it is important to examine mean differences not only in predictor variables (ability in tests in this case), but also criterion variables. In the same way that predictor variables show differential performance, criterion variables can show diffential success among sex and ethnic groups.

With regard to validity, all the BAB tests with the exception of Rhythm, Word Association, and Finger Dexterity-Right had significant correlations with the GPA criterion.

As Table 4 shows for all groups, the following BAB tests correlated significantly with GPA and the 10 subject matter grades: Clerical, Idea Fluency, Paper Folding, Vocabulary, Ideaphoria, and Analytical Reasoning, with the Vocabulary test being the best single predictor of any criterion. In particular, stepwise multiple regression analysis with GPA as a criterion yielded a multiple R coefficient of .54 when the Vocabulary, Clerical, Ideaphoria, and Paper Folding tests were included as predictors.

Insert Table 4 about here

In order to determine if the BAB tests have different effec-

tiveness in predicting criterion performance across sex and ethnic groups, a series of comparisons of the correlation coefficients between the BAB tests and GPA were made, using Fisher's z test. No significant sex differences in validity coefficients for the different BAB tests were found. However, black-white differential validities were found for Word Association, Shape Assembly, and Writing Speed tests. Also, significant black-hispanic differences were reported for Word Association, Finger Dexterity-Right, and Shape Assembly. No significant differences were observed for any sex or ethnic comparison of the validities for the Clerical, Idea Fluency, Tonal Memory, Pitch, Rhythm, Inductive Reasoning, Vocabulary, Ideaphoria, Finger Dexterity-Left, Grip-Left, Grip-Right, and Analytical Reasoning tests. It is interesting to note from the above results that those tests showing significant differential validities were not among the five best predictors of GPA for any sex or ethnic group.

In summary, the data showed that ethnic and sex variables were associated with level differences, but not with the pattern and structure of abilities as measured by the Ball Aptitude Battery. Also, the simplicity of factor patterns indicate that redundancy is minimal for the BAB tests. Furthermore, the findings of few significant differential validities for sex and ethnic

groups indicate that the same battery of ability tests can serve for different ethnic and sex groups.

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Footnote

[1]An earlier draft of this report was given at the annual Multi-Ethnic Conference on the Assessment, Tampa, Florida, March 1982.

Table 1

Means and Standard Deviations for Each Race-by-Sex Group and for Total Group, by Ball Aptitude Battery (BAB) Tests

BAB test	M							SD						
	BF	BM	HF	HM	WF	WM	TG	BF	BM	HF	HM	WF	WM	TG
Clerical	192.0	182.2	192.5	181.7	195.0	184.3	188.9	21.4	23.1	20.5	18.4	19.6	22.8	21.7
Idea Fluency	24.8	24.8	22.9	22.5	30.4	28.8	27.3	10.3	9.6	8.0	9.0	10.5	10.4	10.4
Tonal Memory	14.7	16.3	14.5	15.8	21.2	19.9	18.5	7.6	7.9	7.0	6.7	6.1	6.5	7.2
Pitch Discrimination	20.6	20.5	21.6	19.9	27.8	26.2	24.6	5.6	5.5	5.2	6.5	5.8	5.7	6.6
Rhythm	27.4	26.8	26.0	26.3	27.3	27.0	27.0	2.7	2.3	3.3	3.4	2.2	2.5	2.7
Inductive Reasoning	20.1	20.3	21.4	21.9	22.8	22.4	21.8	4.4	3.5	3.7	4.9	3.3	3.8	4.0
Word Association	26.5	21.1	24.8	23.2	26.8	25.5	25.5	7.2	7.9	7.4	7.9	7.4	7.7	7.6
Writing Speed	153.3	141.8	148.2	147.8	155.6	150.4	150.4	30.5	31.4	29.0	76.6	22.9	33.2	36.7
Paper Folding	6.8	8.2	9.0	10.3	11.4	10.2	10.2	4.1	4.1	4.1	4.9	4.7	4.9	5.0
Vocabulary	27.3	25.6	28.0	25.4	40.8	33.7	33.7	13.0	10.7	12.2	11.3	15.7	15.2	15.4
Ideaphoria	126.0	126.5	142.2	135.0	187.9	152.1	152.1	65.9	58.5	68.5	62.5	63.8	64.9	68.5
Finger Dexterity-Left	41.9	39.0	39.2	41.6	40.2	40.4	40.4	7.3	6.1	5.3	7.7	5.3	5.5	6.1
Finger Dexterity-Right	48.0	45.4	44.9	46.1	46.6	46.1	46.1	6.4	8.2	5.5	5.3	5.8	6.5	6.4
Grip-Left	89.9	146.4	82.9	129.7	90.1	114.0	114.0	18.2	25.3	18.6	25.2	18.0	23.8	34.8
Grip-Right	100.8	159.7	92.8	143.9	100.5	126.0	126.0	16.3	26.2	18.2	24.7	18.3	25.8	36.3
Shape Assembly	9.8	12.9	14.1	16.5	14.9	15.1	15.1	6.4	7.4	7.1	6.8	7.0	6.8	7.5
Analytical Reasoning	23.1	19.9	26.0	22.3	36.7	30.0	30.0	13.8	12.7	14.6	13.8	15.1	15.6	16.0

Note. BF = black females (N = 162); BM = black males (N = 110); HF = hispanic females (N = 92); HM = hispanic males (N = 96); WF = white females (N = 291); WM = white males (N = 258); TG = total group (N = 1009).

Table 2

Means and Standard Deviations for Each Race-by-Sex Group and for Total Group by Academic Criteria

Academic Subjects	M (z = 0)							SD = 1.00						
	BM	BF	WM	WF	HM	HF	TG	BM	BF	WM	WF	HM	HF	TG
Physics	-279	073	058	112	-065	-196	-006	854	759	654	595	784	878	732
Biology	-329	109	008	126	-238	-062	002	879	775	758	719	743	800	784
Economics	-320	052	-022	157	-184	-185	000	830	782	738	629	788	928	796
Math	-216	-031	-067	144	-158	026	-012	805	856	797	699	772	912	798
English	-303	078	-111	200	-208	026	-002	980	726	780	726	783	886	800
Chemistry	-264	020	028	018	-068	153	000	751	642	646	558	658	508	622
SCI. AVER.	-324	111	016	110	-167	-105	000	916	797	736	696	785	896	784
Soc. Studies	-244	090	-062	178	-148	-061	000	803	840	777	650	906	1,032	754
Foreign Language	-467	046	-063	058	-014	346	-001	844	734	642	622	828	858	737
GPA	-354	076	-044	166	-242	000	-006	927	722	782	682	692	912	784

Note. BM = black male (N = 250); BF = black female (N = 152); WM = white male (N = 210); WF = white female (N = 265); HM = hispanic male (N = 73); HF = hispanic female (N = 85); TG = total group (N = 883). Decimal points are omitted.

Table 3

Coefficients of Factor Congruence Between Race and Sex Groups, by Factor

Factor	Group Comparison			
	B vs. H	B vs. W	H vs. W	F vs. M
Grip	.969	.979	.973	.987
Finger Dexterity	.922	.958	.936	.871
Spatial	.921	.959	.929	.980
Fluency	.914	.888	.902	.962
Musical	.827	.875	.974	.989
Word Association	.785	.940	.859	.813
Rhythm	.827	.848	.917	.972
Clerical	.885	.893	.853	.882
Inductive Reasoning	.793	.735	.881	.848
Vocabulary	.547	.706	.692	.913
Analytical Reasoning	.786	.809	.899	-[a]
Writing Speed	.845	.826	.640	-[a]

Note. B = black; H = hispanic; W = white; F = female; M = male.

[a]This factor did not appear in the factor analyses.

Table 4

Correlations Between BAB Tests and Grade Point Average for Sex and Ethnic Groups[a]

BAB Test	Total Group	Male	Female	Black	White	Hispanic
Clerical	.3001 (574)***	.2925 (253)***	.2648 (321)***	.3021 (188)***	.3325 (250)***	.2267 (121)***
Idea Fluency	.2846 (574)***	.2194 (253)***	.3191 (321)***	.2550 (189)***	.2208 (250)***	.4271 (120)***
Tonal Memory	.1488 (221)**	.0990 (94)	.1839 (127)*	.3001 (45)*	.0689 (89)	.1972 (76)*
Pitch	.2081 (220)***	.1008 (94)	.2415 (126)**	.2945 (44)*	.2150 (89)*	.2409 (76)*
Rhythm	.0311 (220)	.0628 (94)	-.0013 (126)	.1894 (44)	.1238 (89)	-.0566 (76)
Inductive Reasoning	.1093 (576)**	.1735 (254)**	.0674 (322)	.0450 (189)	.1638 (251)**	.0883 (121)
Word Association	.0562 (576)	.0570 (255)	-.0038 (321)	.1797 (189)**	-.0880 (251)	.1733 (121)*
Writing Speed	.1477 (559)***	.1833 (248)**	.1020 (311)*	.2973 (177)***	.1747 (248)**	.0662 (119)
Paper Folding	.2723 (576)***	.3397 (254)***	.2690 (322)***	.2510 (189)***	.3249 (251)***	.1603 (121)*
Vocabulary	.4304 (575)***	.4348 (253)***	.4257 (322)***	.3762 (188)***	.3955 (251)***	.5250 (121)***
Ideaphoria	.3263 (572)***	.3158 (253)***	.3040 (319)***	.2519 (185)***	.3236 (251)***	.3739 (121)***
F.D.-Left	.0973 (570)**	.0899 (250)	.0881 (320)	.1768 (185)**	.1546 (250)**	-.1492 (120)
F.D.-Right	-.0063 (569)	-.1026 (249)	.0402 (320)	.0646 (185)	.0211 (250)	-.1601 (119)*
Grip-Left	-.1612 (502)***	.0862 (226)	-.0803 (276)	-.2019 (150)**	-.1715 (237)**	-.1762 (102)*
Grip-Right	-.1428 (504)***	.1159 (228)*	-.0427 (276)	-.1486 (152)*	-.1604 (238)**	-.1894 (101)*
Shape Assembly	.1234 (529)**	.2094 (238)***	.1392 (291)**	.0793 (163)	.1330 (241)*	.0992 (111)
Analytical Reasoning	.3269 (533)***	.3570 (240)***	.2843 (293)***	.1635 (166)*	.3964 (242)***	.3558 (111)***

[a]The number in parenthesis is sample size.

*$p < .05$, **$p < .01$, ***$p < .001$.